M. Tech.-I (Civil-Hydraulic Engineering) (CBCS – 2015 Course) :
SUMMER - 2019
SUBJECT: ADVANCED FLUID MECHANICS

Day: Thursday
Date: 16/05/2019

S-2019-3369

Time: 11.00 AM TO 02.00 PM
Max. Marks: 60

N.B.:

1) All questions are **COMPULSORY**.
2) Figures to the right indicate **FULL** marks.
3) Answers to both the sections should be written in SAME answer book.
4) Draw neat labeled diagrams **WHEREVER** necessary.

SECTION-I

Q.1 **a)** Define and distinguish between stream line, path line and streak line. When they coincide and do not coincide? **(05)**

b) If $u = \frac{-y}{b^2}$ and $v = \frac{x}{a^2}$ where a and b are constants. Find the equation of streamline passing through (a, 0) **(05)**

OR

Q.1 Derive 3-D continuity equation in cylindrical polar co-ordinates. **(10)**

Q.2 **a)** For 2-D rotational flow show that $\Delta^2\Psi = 2\omega_z$ with usual notations. **(05)**

b) Stream function Ψ is given by $\Psi = 8\left(x^2 + y^2\right)$. Prove that the flow is rotational. Determine magnitude and direction of velocity at (2, 3). **(05)**

OR

Q.2 What are the methods to draw flow net? Describe any one method to draw flow net. What are limitations of flow net? **(10)**

Q.3 Starting from Euler's equations of motion along a streamline, obtain Bernoulli's equation. List all the assumptions made and limitations of Bernoulli's equations. **(10)**

OR

Q.3 Define energy correction and momentum correction factors. Derive the mathematical expression for them. **(10)**

SECTION- II

Q.4 **a)** Derive an expression for velocity distribution for viscous flow through a circular pipe. Also sketch the distribution of velocity and shear stress across a section of pipe. **(05)**

b) Explain different types of hydraulic similarities that must exist between prototype and its model. **(05)**

OR

Q.4 **a)** For a laminar flow in pipe, pressure difference is given by $\Delta p = 32\frac{\mu UL}{D^2}$, obtain expression for friction factor f. **(05)**

b) Starting from Navier-Stokes equations in Cartesian co-ordinate system, show that for creeping flow, pressure satisfies Laplace equation. **(05)**

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Q.5 **a)** Derive Von Karman's momentum integral equation. **(05)**

b) Define displacement thickness (δ^*), momentum thickness (θ) and energy thickens (δ^{**}) for boundary layer and write expressions of each. **(05)**

OR

Q.5 **a)** Explain the phenomenon of boundary layer separation and discuss the methods of controlling or delaying separation. **(05)**

b) Draw a neat sketch of boundary layer on a flat plate and give equations for $\frac{\delta}{x}$, c_f and C_f in different regions. **(05)**

Q.6 **a)** Describe characteristics of turbulent flow. **(05)**

b) Derive the expression for velocity distribution in a hydrodynamically rough pipe. **(05)**

OR

Q.6 **a)** State Reynolds rules of averages and obtain the value of $\overline{pu}$ if $p = \bar{p} + p'$ and $u = \bar{u} + u'$. **(05)**

b) Obtain the continuity equation for time averaged velocity component $\bar{u}, \bar{v}, \bar{w}$. **(05)**

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